

Abstract

Introduction:

The Rural Obstetric Ultrasound Program (ROUSG) was introduced to enhance early detection and referral through ultrasound screening during the 24th week of gestation. The objectives of the study were to assess the effectiveness of the ROUSG program in enhancing antenatal care (ANC) visits, promoting facility-based deliveries, identifying complications during pregnancy, and reducing maternal and perinatal mortality.

Methods:

A retrospective study was conducted in seven health facilities of Kailari Rural Municipality, Kailali District, Nepal. ANC records of women aged 20-49 were compared across 12 months before and after the implementation of ROUSG. Data was analyzed using SPSS 29.0. Descriptive statistics and inferential tests (t-test, Chi-square, Fisher's Exact), with significance set at $p \leq 0.05$.

Results:

There were no significant changes in service utilization, with the attendance rate at the first ANC visit slightly decreasing from 8.7% to 7.7% and facility deliveries remaining stable at 51.2% and 50.7%. However, detection of complications improved, including malpresentation (1.1% to 1.9%), abortion (1.6% to 2.1%), and hypertension (1.1% to 2.3%). The number of assisted deliveries increased significantly, and referrals for complications also rose. Maternal mortality remained at zero, and neonatal mortality stayed low throughout the study period.

Conclusion:

The ROUSG program improved the detection of pregnancy-related complications but did not significantly increase early ANC attendance or facility-based deliveries. This suggests that diagnostic tools alone are not enough to change maternal care-seeking behaviors in Nepal. Persistent barriers such as cultural norms, transportation challenges, and inadequate counseling continue to limit service utilization.

Key Words: antenatal visit, health facility delivery, maternal and neonatal mortality, pregnant mother, Rural obstetric ultrasound program (ROUSG)

Introduction

Antenatal care (ANC) reduces maternal and perinatal morbidity and mortality directly by detecting and treating complications, and indirectly by identifying women at risk and ensuring referral to appropriate services.^{1,2} The purpose of ANC is to monitor and support pregnant women, maximize health outcomes, and provide timely treatment and referral.³ However, rural women face barriers such as distance, transport, and limited service availability.³ Nepal has made progress in maternal health, with the maternal mortality ratio decreasing from 539 per 100,000 live births in 1998 to 151 in 2022.⁴⁻⁷ Still, many maternal deaths are linked to incomplete ANC visits and regional disparities.⁸ To address gaps, the Rural Obstetric Ultrasound Program (ROUSG) enables early complication detection, timely referral, and improved institutional delivery, strengthening maternal health services.⁹⁻¹⁴

1) Objectives

This study aims to evaluate the effectiveness of the ROUSG program in enhancing ANC visits, promoting health facility deliveries, identifying complications during the ANC period, and reducing maternal and perinatal mortality.

Methods

1) Study Design

Descriptive retrospective study

2) Place and duration of study

In Kailali District, six rural local governance bodies implemented the ROUSG program, with Kailari Rural Municipality being one of them. ROUSG services were introduced in 2019, and Kailari Rural Municipality saw a high number of antenatal visits by mothers in 2020–2021. Women (20 to 49 years) with complete ANC records (maternal logbook) who used the seven healthcare facilities for 12 months before the program (July 16, 2020 to July 15, 2021) and 12 months after program (July 16, 2021 to July 15, 2022) were included.

3) Ethical approval

Ethical approval was obtained from the Institutional Review Board of Juntendo University, Japan (Reg. No. 2024-60), and the Institutional Review Board of the Nepal Health Research Council (Reg. No. 657_2024, Nepal).

4) Inclusion and Exclusion criteria

The inclusion criteria were 20 to 49 years of age pregnant mother. The exclusion criteria were less than 20 years and more than 49 years.

5) Sample Size and sampling

All mothers who attended 7 health facilities during the one-year study period will be included; no sampling will be performed.

6) Statistical analysis and software used

The Statistical Package for Social Sciences (IBM) version 29.0 was used to analyze the dataset. Descriptive statistic measures, such as frequencies and percentages, were used to describe the distribution of outcomes across both periods. For inferential statistics, the data were subjected to tests for normality. The independent sample t-test, chi-square test, and Fisher's exact test were used to examine the association between the ROUSG program and the total number of ANC visits, institutional deliveries, and complications identified during the antenatal period. Maternal and perinatal mortality and significance were set at $P \leq 0.05$.

Results

Table 1 shows the socio-demographic characteristics of respondents for 2020-2021 (n = 619) and 2021-2022 (n = 570). The majority of participants were aged 20-29 years, representing 83.0% and

78.1% of the total in each period, respectively, with no significant difference in age between the groups ($p = 0.56$).

A significant difference was observed in educational attainment ($p = 0.001$). The proportion of respondents with secondary education was notably higher in 2021-2022 (29.6%) compared to 2020-2021 (14.2%). Similarly, participants with higher education accounted for 6.0% in 2021-2022, which exceeded 2.9% in the previous period. Conversely, education was more prevalent in 2020-2021 (81.9%) than in 2021-2022 (63.7%).

Employment status showed a nonsignificant increase in employment in 2021–2022 (5.4%) compared to 2020-2021 (3.2%; $p = 0.061$).

No statistically significant differences were found in obstetric variables, including gravida and parity. Primigravida accounted for 56.2% and 53.0%, multigravida for 40.7% and 44.2% ($p = 0.473$), and nulliparity for 58.8% and 56.8% ($p = 0.768$) in the respective periods.

Table 1. Socio-demographic characteristics of respondents between 2020–2021 and 2021–2022

Variables	2020-2021 (n=619)		2021-2022(n=570)		
Age (Years)	Number	Percentage	Number	Percentage	p-value
20-29	519	83.00%	445	78.1%	0.56*
30-39	101	16.3%	123	21.6%	
40-49	4	0.6%	2	0.4%	
Education					
No education	6	1.0%	4	0.7%	0.001*
Basic education	507	81.9%	363	63.7%	
Secondary education	88	14.2%	169	29.6%	
Higher education	18	2.9%	34	6.0%	
Occupation					
Employment	20	3.2%	31	5.4%	0.061**
Unemployment	599	96.8%	539	94.6%	
Gravida					
Primigravida	348	56.2%	302	53.0%	0.473**
Multi gravida	252	40.7%	252	44.2%	
Grand multi-gravida	19	3.1%	16	2.8%	
Para					
Nulliparity	364	58.8%	324	56.8%	0.768**
Low multiparity	249	40.2%	241	42.3%	
Grand multi parity	6	1.0%	5	0.9%	

*Fisher-Exact Test, **Chi-square Test

Table 2 summarizes the record of ANC visits and delivery locations for 2020-2021 (n = 619) and 2021-2022 (n = 570). The proportion of women attending their first ANC visit was 8.7% in 2020-2021 and slightly decreased to 7.7% in 2021–2022, with a consistent mean attendance of 0.95 (SD = 0.22) in both years ($p = 0.756$).

Attendance at the second ANC visit remained relatively stable, with 6.3% in 2020-2021 and 6.7% in 2021-2022. Mean attendance increased marginally from 0.90 (SD = 0.29) to 0.92 (SD = 0.25; $p = 0.100$). The third ANC visit showed an increase in attendance from 7.1% to 9.8%, while mean attendance remained at 0.87; however, the standard deviation rose from 0.33 to 0.55 ($p = 0.822$). The fourth ANC visit was attended by 77.9% of women in 2020-2021 and 75.8% in 2021-2022, with a slight decrease in mean attendance from 0.82 (SD = 0.38) to 0.79 (SD = 0.40; $p = 0.132$). Concerning delivery location, 317 women (51.2%) delivered inside a health facility in 2020–2021 compared to 289 (50.7%) in 2021-2022. The mean remained stable at 1.49 (SD = 0.500) in both years, and the p-value (0.817) indicated no significant difference. Conversely, deliveries outside health facilities were reported in 302 women (48.8%) in 2020-2021 and 281 (49.3%) in 2021-2022. The mean slightly decreased from 1.52 to 1.51, with no meaningful variation (SD = 0.50 in both years), and the difference was also not significant ($p = 0.774$).

Table 2. Record of ANC visits and hospital delivery between 2020–2021 and 2021–2022

Variables	2020-2021			2021-2022			p- values
	N (%)	Mean	S. D	N (%)	Mean	S. D	
1 st ANC Visits	54 (8.7)	0.95	0.22	44 (7.7)	.95	0.22	0.756
2nd ANC Visits	39 (6.3)	0.90	0.29	38 (6.7)	.92	0.25	0.100
3 rd ANC Visit	44 (7.1)	0.87	0.33	56 (9.8)	.87	0.55	0.822
4 th ANC visits	482 (77.9)	0.82	0.38	432 (75.8)	.79	0.40	0.132
Inside the Health facility	317 (51.2)	1.49	0.500	289 (50.7)	.49	0.500	0.817
Outside the Health Facility	302 (48.8)	1.52	0.500	281 (49.3)	.51	0.50	0.774

Independent sample T test, SD: Standard Deviation

ANC: Antenatal care

Obstetric complications (Table 3) remained low during 2020-2021 (n = 28) and 2021-2022 (n = 48). Most women had no complications (95.0% vs. 91.1%), and the slight increase was not statistically significant ($p = 0.304$). Malpresentation rose from 1.1% to 1.9%, abortion-related complications from 1.6% to 2.1%, and hypertension from 1.1% to 2.3%, while placenta previa remained at 0.5%. Rare complications (<1%) included IUFD, macrosomia, and multiple

pregnancies; anencephaly and oligohydramnios appeared in 2021-2022 (0.4% and 0.2%). Maternal mortality remained 0%, and neonatal mortality was low (0.3%-0.2%; $p = 0.531$).

Table 3. Analysis of complications identified in the ANC period and maternal and neonatal mortality between 2020–2021 and 2021–2022

Variable	2020-2021 (n=28)		2021-2022 (n=48)		
Complication identified	Number	Percentage	Number	Percentage	p- value
No Complication	588	95.0%	519	91.1%	.304
Malpresentation	7	1.1%	11	1.9%	
Abortion	10	1.6%	12	2.1%	
Hypertension	7	1.1%	13	2.3%	
Placenta Previa	3	0.5%	3	0.5%	
Big baby	2	0.3%	3	0.5%	
IUFD	1	0.2%	4	0.7%	
Twins	1	0.2%	2	0.4%	
Anencephaly	0	0.0%	2	0.4%	
Oligohydraminous	0	0.0%	1	0.2%	
Mortality					
Maternal	0	0.0%	0	0.0%	0.531
Neonatal	2	0.3%	1	0.2%	

Fisher's Exact Test

The distribution of delivery methods changed significantly between 2020–2021 and 2021–2022. In vaginal deliveries decreased from 83.4% to 73.3%, assisted deliveries increased from 5.6% to 12.1%, cesarean deliveries rose from 7.9% to 10.3%, and Dilatation and Evacuation procedures increased from 3.0% to 4.3%. (Table 4).

Table 4. Record of referred cases management plan between 2020–2021 and 2021–2022

Variables	2020-2021 (n=302)		2021-2022(n=281)		
Change in management	Number	Percentage	Number	Percentage	p-value
Vaginal Delivery	252	83.44%	206	73.30%	0.032
Assisted Delivery	17	5.62%	34	12.09%	
Cesarean Delivery	24	7.94%	29	10.32%	
Dilation and Evacuation	9	2.98%	12	4.27%	

Chi-square Test

Discussion

Ultrasound is critical in antenatal care, enabling early detection of high-risk pregnancies and complications.¹⁵⁻²¹ It plays a key role in detecting high-risk pregnancies and potentially life-threatening complications, enabling timely diagnosis and management.^{10,18} In Nepal, rural health facilities have been equipped with ultrasound to improve the identification of conditions not

detectable through physical examination alone. Recognizing this, the Government of Nepal has expanded access to ultrasound in rural facilities to enhance the detection of pregnancy complications that might otherwise go unnoticed.^{9 19}

National data show improvements in ANC coverage and completion of four visits²², which aligns with stable ANC attendance observed in this study. While studies in Nigeria¹⁰ reported improved ANC utilization following ultrasound introduction, our findings diverge. The ROUSG program did not significantly increase early ANC attendance. However, early ANC visits remained low, likely due to persistent barriers such as limited awareness, cultural preferences, transportation challenges, and inadequate counseling.^{13 16 23-26} Concurrent national programs, Nepal's Safe Motherhood and Aama initiatives, may also have influenced ANC attendance independently.⁴ Evidence from a cluster-randomized trial across five countries found that routine rural obstetric ultrasound did not improve ANC attendance, facility deliveries, or maternal and neonatal outcomes.³⁰ Such results highlight that ultrasound alone cannot address systemic barriers such as weak referral systems, limited infrastructure, or insufficiently trained staff.²⁹⁻³⁰

Our findings also contrast with reports from Nigeria¹⁰ and rural Australia³³, where ultrasound access increased facility deliveries and maternal engagement. In Nepal, despite the availability of ROUSG, health facility deliveries did not rise. Barriers such as cultural preferences for home births³¹, difficult terrain and poor transport¹⁵, financial constraints³², limited male involvement²⁴, and inadequate counselling¹⁷ continue to limit progress.

However, complication detection improved markedly from 2020–2022; reported rates of malpresentation, placenta previa, hypertension, IUFD, and congenital anomalies all increased. These trends are consistent with studies in Ghana, Uganda, Nigeria, and Nepal, which demonstrated that ROUSG enhanced the detection of complications, including malpresentation, placenta previa, hypertension, IUFD, and rare conditions, consistent with reports from other countries.^{10 13 15 17 27-30} Although ANC attendance did not improve, enhanced detection indicates that ROUSG strengthened diagnostic capacity and maternal risk management. Despite improved detection, early ANC attendance and health facility deliveries did not significantly increase, reflecting ongoing structural, financial, and cultural barriers.^{24 31 32}

WHO recommends one ultrasound before 24 weeks of gestation to assess gestational age, detect anomalies, and improve the pregnancy experience.²⁰ Our findings reinforce this recommendation: early ultrasound facilitated timely identification of complications and informed obstetric management. The observed decline in normal deliveries and increase in cesarean and complicated births highlight the need for strengthened obstetric care, including timely referral, skilled staff, emergency care availability, and respectful maternity care.²¹

Finally, the modification of clinical management plans following complication detection was evident in this study, consistent with evidence from Nigeria.¹⁰ In Nepal's health system, primary-level facilities lack the capacity to manage high-risk pregnancies; thus, national guidelines emphasize referral once complications are detected.⁹ Early detection through ROUSG likely contributed to earlier referrals and preventive interventions, even if overall service utilization indicators remained unchanged. This suggests that while ultrasound alone cannot drive improvements in ANC uptake or facility deliveries, it adds substantial value in risk detection, referral, and clinical decision-making. Overall, ROUSG improved diagnostic capabilities and maternal risk management, highlighting that technology alone must be paired with community engagement, counseling, and infrastructure support to maximize maternal and neonatal outcomes.

1) Limitation

This study was limited by its reliance on health facility records, which may be incomplete or inaccurate, particularly in rural areas with manual record-keeping and inconsistent documentation. The analysis did not capture personal, cultural, or logistical factors influencing ANC attendance and facility deliveries, such as transportation challenges, family influence, or individual preferences. The study was conducted in a single district over two years, limiting the generalizability of the findings. Additionally, the quality and consistency of ultrasound services across facilities were not assessed, which may have affected the detection and management of complications.

Conclusion

The ROUSG program improved the detection of pregnancy-related complications, including malpresentation, hypertension, and IUFD, but did not significantly increase early ANC attendance or health facility deliveries. This indicates that enhanced diagnostic capacity alone is insufficient to change maternal care-seeking behavior in rural Nepal. Persistent barriers such as cultural preferences for home births, transportation challenges, and limited counseling likely contributed to this outcome. Nevertheless, the identification of complications influenced delivery management, highlighting the program's critical role in clinical decision-making. Strengthening community engagement, health worker counseling, and referral systems is essential to maximize the benefits of ultrasound and improve maternal and neonatal outcomes.

Acknowledgement

We especially thank Professor Sakurai Shinobu and Professor Jun Ueki for advising us on the research proposal for this study, and also thank Dr Khagendra Raj Bhatta and Meena Chand for helping in collecting the data.

References

1. Sitaula S, Basnet T, Agrawal A, Manandhar T, Das D, Shrestha P. Prevalence and risk factors for maternal mortality at a tertiary care centre in Eastern Nepal: retrospective cross-sectional study. *BMC Pregnancy Childbirth*. 2021;21(1):471. doi: 10.1186/s12884-021-03920-4
2. Carroli G, Rooney C, Villa J. How effective is antenatal care in preventing maternal mortality and serious morbidity? An overview of the evidence. *Paediatr perinat Epidemiol*. 2001;15:1-42.
3. Bidner A, Bezak E, Parange N. Antenatal ultrasound needs-analysis survey of Australian rural/remote healthcare clinicians: recommendations for improved service quality and access. *BMC Public Health*. 2023;23(1):2268. doi: 10.1186/s12889-023-17106-4 [published Online First: 20231117]
4. Aryal KK, Sharma SK, Khanal MN, Bista B, Sharma SL, Kafle S, et al. Maternal Health Care in Nepal: Trends and Determinants. Rockville: ICF; 2019. Report No. 118.
5. Department of Health Services. Nepal Safe Motherhood and Newborn Health Road Map 2030. Kathmandu (Nepal): Family Welfare Division; 2019.
6. Family Welfare Division. ANC to PNC continuum of care guideline. Kathmandu (Nepal): Family Welfare Division; 2022.
7. Ministry of Health and Population, New Era, ICF. Nepal Demographic Health Survey 2022. Kathmandu (Nepal): Ministry of Health and Population; 2023.
8. Ministry of Health and Population, National Statistics Office. A report on maternal mortality. Kathmandu (Nepal): Ministry of Health and Population; 2021.
9. Ministry of Health and Population. Rural Obstetric Ultrasound Programme for Nurses, Final Reference Manual. Kathmandu: Ministry of Health and Population; 2022a.
10. Luntsi G, Ugwu AC, Ohagwu CC, Kalu O, Sidi M, Akpan E. Impact of ultrasound scanning on pregnant Women's compliance with attendance at antenatal care visits and supervised delivery at primary healthcare centres in northern Nigeria: Initial experiences. *Radiography (Lond)*. 2022;28(2):480-86. doi: 10.1016/j.radi.2022.01.003.
11. Ministry of Health and Population. Rural Obstetric Ultrasound Training (ROUSG) For Nurses, Teku, Kathmandu: National Health Training Center; 2022b.
12. Kozuki N, Mullany LC, Khatry SK, Ghimire RK, Paudel S, Blakemore K, et al. Accuracy of Home-Based Ultrasonographic Diagnosis of Obstetric Risk Factors by Primary-Level Health Care Workers in Rural Nepal. *Obstet Gynecol*. 2016;128(3):604-12. doi: 10.1097/AOG.0000000000001558.
13. Kim C, Wagle K, Shrestha B, Bhatta S, Maharjan S, Dhakal L, et al. Perceptions of service providers, service recipients, and female community health volunteers on a rural obstetric ultrasound program in rural Nepal: a qualitative study. *BMC Pregnancy Childbirth*. 2023;23(1):574. doi: 10.1186/s12884-023-05876-z.
14. Franklin HL, Mirza W, Swanson DL, Newman JE, Goldenberg RL, Muyodi D, et al. Factors influencing referrals for ultrasound-diagnosed complications during prenatal care in five low and middle-income countries. *Reprod Health*. 2018;15(1):204. doi: 10.1186/s12978-018 0647-8.
15. Jagadish J, Sherpa. MG, Sherpa. LY, Lama N, Maharjan M, Lama LD, et al. Effectiveness of Focused Obstetric Ultrasound Training to Nurses from Remote Health Posts to Improve Pregnancy Outcome and Reduce Morbidity. *J Nepal Health Research Council* 2023;21(59):303-08.

16. Holmlund S, Ntaganira J, Edvardsson K, Lan PT, Semasaka Sengoma JP, Ahman A, et al. Improved maternity care if midwives learn to perform ultrasound: a qualitative study of 8 Rwandan midwives' experiences and views of obstetric ultrasound. *Glob Health Action*. 2017;10(1):1350451. doi: 10.1080/16549716.2017.1350451
17. Mensah YB, Nkyekyer K, Mensah K. The Ghanaian woman's experience and perception of ultrasound use in antenatal care. *Ghana Med J*. 2014;48(1):31-8. doi: 10.4314/gmj.v48i1.5
18. Witworth M, Bricker L, Mullan C. Ultrasound for fetal assessment in early pregnancy. *Cochrane Database Syst Rev* 7. 2015; CD007058. <https://doi.org/10.1002/14651858.pub3>.
19. Phommachanh S, Essink DR, Jansen M, Broerse JEW, Wrigt P, Mayxay M. Improvement of Quality of Antenatal Care (ANC) Service Provision at the Public Health Facilities in Lao PDR: Perspective and Experiences of Supply and Demand Sides. *BMC Pregnancy Childbirth*. 2019;19(1):255. doi: 10.1186/s12884-019-2345-0.
20. World Health Organization. World Health Organization recommendations on antenatal care for a positive pregnancy experience. Geneva: World Health Organization;2016a
21. World Health Organization. Standards for improving the quality of maternal and newborn care in health facilities. Geneva: World Health Organization; 2016b.
22. Department of Health Services. Annual Health Report 2080/81. Kathmandu: Ministry of Health and Population; 2025.
23. Ali S, Kabajaasi O, Kawooya MG, Byamugisha J, Zakus D, Papageorghiou AT, et al. Antenatal Doppler ultrasound implementation in a rural sub-Saharan African setting: exploring the perspectives of women and healthcare providers. *Reprod Health*. 2021;18(1):199. doi: 10.1186/s12978-021-01233-5.
24. Karkee R, Tumbahanghe KM, Morgan A, Maharjan N, Budhathoki B, Manandhar DS. Policies and actions to reduce maternal mortality in Nepal: perspectives of key informants. *Sex Reprod Health Matters*. 2021;29(2):1907026. doi: 10.1080/26410397.2021.1907026.
25. Nyando M, Makombe D, Mboma A, Mwakilama E, Nyirenda L. Perceptions of pregnant women on antenatal care visits during their first trimester at Area 25 health center in Lilongwe, Malawi - a qualitative study. *BMC Women's Health*. 2023;23(1):646. doi: 10.1186/s12905-023-02800-7.
26. Kozuki N, Katz J, Khatri SK, Tielsch JM, LeClerq SC, Mullany LC. Community survey on awareness and use of obstetric ultrasonography in rural Sarlahi District, Nepal. *Int J Gynaecol Obstet*. 2016;134(2):126-30. doi: 10.1016/j.ijgo.2016.01.015.
27. Shah S, Santos N, Kisa R, Tumusiime J, Nabirye RC, Ayebare F, et al. Efficacy of an ultrasound training program for nurse midwives to assess high-risk conditions at labor triage in rural Uganda. *PLoS One* 2020;15(6):e0235269. doi: 10.1371/journal.pone.0235269.
28. Kim ET, Singh K, Moran A, Smith J, Chen L, Patel R, et al. Obstetric ultrasound use in low and middle-income countries: a narrative review. *Reprod Health*. 2018;15(1):129. doi: 10.1186/s12978-018-0571-y.
29. Sondaal AEC, Tumbahangphe KM, Neupane R, Smith J, Lee H, Sharma P, et al. Sustainability of community-based women's groups: reflections from a participatory intervention for newborn and maternal health in Nepal. *Community Dev J*. 2019;54(4):731-49. doi: 10.1093/cdj/bsy017.
30. McClure EM, Saleem S, Esamai F, Garces A, Chomba E, Tshetu A, et al. First Look: a cluster randomised trial of ultrasound to improve pregnancy outcomes. *BMC Pregnancy Childbirth*. 2014;14:73.

31. Devkota B, Maskey J, Pandey AR, Shrestha N, Koirala S, Adhikari S, et al. Determinants of home delivery in Nepal: a disaggregated analysis of marginalised and non-marginalised 9 women from the 2016 Nepal Demographic and Health Survey. *PLoS One*. 2020;15(1):e0228440. doi:10.1371/journal.pone.0228440.
32. Thasineku OC, Pandit S, Acharya D, Shrestha R, Lama P, Gurung A, et al. Associated factors for the utilization of institutional delivery services in Nepal: findings from the Nepal Demographic Health Survey, doi:10.1371/journal.pone.03223.
33. Doing M, Bidner A, Dizon J, Smith R, Lee H, Patel K, et al. Availability and use of antenatal point-of-care ultrasound services within rural South Australia health care. *Aust J Rural Health*. 2022;30(2):281–285. doi:10.1111/arj.12811.